On the Voiced-Voiceless Distinction in Stops of English

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Kim, Dae-Won. 2002. **On the Voiced-Voiceless Distinction in Stops of English.** *Korean Journal of English Language and Linguistics* 2-1, 23-30. Phonologically, the difference between the English stops /b, d, g/ and /p, t, k/ is carried by the presence or the absence of the vocal fold vibration throughout their oral closure phase. If phonology has its foundation in phonetics, there must be phonetic evidence for the voiced-voiceless distinction. This study is aimed to determine whether or not the voiced-voiceless distinction is acceptable or proper in English. The determination was based mainly on findings in the existing literature and in informal experiments. In conclusion, there is no phonetic evidence for the voiced-voiceless distinction both in production and perception. The [voice] appears to be one of potential phonetic correlates of the phonologically voiced stop. It is improper to use the [voice] as independent phonological marker, regardless of position (word-initial, intervocalic, word-final). A feature other than the voiced-voiceless feature must distinguish /b, d, g/ from /p, t, k/.

1. Introduction

In English phonology, the [voice] has been considered to be the primary feature in production and perception. Normally, all vowels, nasals and semi-vowels are considered to be voiced. The other consonants of English are classified into voiced and voiceless sounds. No allophones of a phoneme function to differentiate the meaning at the level of word. The classificatory theory developed by D. Jones (1957) considers the phoneme to be a group or family of related [allophonic] sounds. For example, /p/ in English consists of an aspirated [p^h], an unaspirated

[p], an unreleased [p˺], etc. The distinctive feature theory, developed by Trubetzkoy (1939), considers a phoneme to be a bundle of distinctive features. For example, /p/ in English is made up of bilabial + stop + voiceless. Aspiration is considered to be redundant in English phonology. Phonologically, thus, the difference between the voiced and voiceless stop consonants is carried by the presence or the absence of the vocal fold vibration throughout their oral closure phase as seen in figure 1.

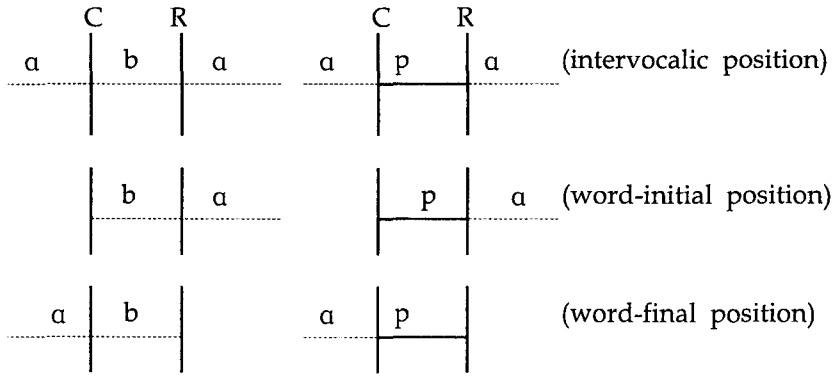

Figure 1. Diagrams showing the difference in voicing between voiced and voiceless stops during their oral closure phase (where the dot line indicates voicing and the other straight line voiceless, the line C the onset of oral closure and the line R the moment of release).

If phonology has its foundation in phonetics, there must be phonetic evidence for the voiced-voiceless distinction. Within the frame of descriptive linguistics, researchers are not to describe what they feel about speech sounds but to describe what the speakers do when the speakers communicate thoughts and ideas using speech sounds. This study is aimed to determine whether or not the voiced-voiceless distinction is acceptable or proper in English mainly on the basis of the existing literature and informal experiments with Korean speakers using VCV words where the V was /ɑ/ and the C bilabial stops.

2. Discussion of Previous Studies on Voicing

In supporting the voiced-voiceless distinction, Lisker and Abramson (1964) claimed that "certainly none of the acoustic features which have been suggested as correlates of a fortis/lenis dimension is demonstrably independent of voicing" (p. 387) (For similar argument, see Fant 1960; Jaeger 1983). The feature [lax] was interpreted to be conflated with the feature [voicing] and the feature [tense] was identified with the feature [voiceless]. Catford (1977:204) maintained that "although there are languages (e.g., Korean) for which a precisely defined parameter of consonantal tenseness may be postulated, English is not one of them and that we are entitled to describe the difference between English /b, d, g/ and /p, t, k/ in terms of voicing: the former being actually or potentially voiced—that is, always involving some degree of glottal constriction not present in /p, t, k/" (for similar claims, see Lisker and Abramson 1964; Fromkin 1966; Lubker and Parris 1970).

Ironically, however, it is difficult or almost impossible to find a phonetic basis for the voiced-voiceless distinction in the existing literature. Although there are a number of informal observations of the presence/absence of voicing in English stops, there have been few systematic observations of this important phenomenon in the published literature. In a spectrographic study, for example, Lisker and Abramson (1964) found that in isolated word-initial position, only one of four American speakers produced most of phonologically voiced stops with closure voicing (for a similar result, Flege and Brown 1982). Three of four speakers produced most of the voiced stops with no voicing or a substantial period of devoicing. In a study (Flege and Brown 1982) with /CVCV/ words where the first vowel, /a/, was always stressed and the second vowel was a central vowel, it was found that in utterance-final words, post-stressed /b/ was

partially devoiced by half of the speakers while in utterance-initial position only two of eight speakers produced with closure voicing. In the utterance-initial /b/, altogether mean 79% of the closure interval was devoiced (Table 1). In the study, about 8% of the intervocalic /p/ tokens were fully voiced and mean 25% of the /p/ closure interval was voiced while altogether 82% of the intervocalic /b/ tokens were fully voiced. However, one of eight American speakers produced the intervocalic /b/ with a break in voicing much more frequently (80% of stops) than any other speaker. She gave the first half of her intervocalic /b/ closure intervals—which averaged about 80 ms in duration—with voicing. The American speakers showed a remarkable variability in voicing in the articulation of phonologically voiced stop consonants. The throat microphone used in the study (Flege and Brown 1982) is designed to pick up both the actual physiological vibration of the vocal folds and the passive vibration of the vocal folds, such as false or inertial vibration without complete closure and opening of the vocal folds. In an informal experiment, the false or inertial vibration was observed to be an average 21 ms. If the false vibration is taken into consideration, the number of fully voiced /b/ and the voicing period during its oral closure phase would be decrease, and the amount of variability in voicing would increase to a considerable extent.

In an experimental study (Kim 1987) with eight British English speakers using isolated nonsense /VCV/ words where the vowel was /ɑ/ and C stop consonants, it was observed that the intervocalic voiced stops were produced generally with a substantial period of devoicing. The devoiced period of the phonologically voiced intervocalic stops was a mean 65% (±13.6) of the oral closure interval (for a similar results, see Kim 1984). In a study (Kim 1989) with natural speech (e.g., 'Are they mobbing the stores?,' etc.), on the other hand, the devoicing period of the intervocalic voiced stops (mean 36% of the oral

closure phase) was less than in the isolated words. In the natural speech, the duration of the vocal fold vibration as percentage of the voiced stop closure interval ranged from 9% to 100%, giving mean 64% and altogether the standard deviation for it was ±31.085. In an informal experiment with two Korean speakers with a near Seoul accent using /CVC/ words, i.e., /bɑl/ (foot), /p^hɑl/ (arm) and /p'ɑl/ (sucking), in isolation and in a carrier phrase '/igəsin ___ idɑ/,' Voice Onset Time (VOT) as an acoustic cue or a phonological marker was measured. In isolated VCV words, VOT was mean (across 20 tokens) 47 ms (±6) for the moderately aspirated lax stop /b/, mean 82 ms (±10) for the heavily aspirated tense /p^h/ and mean 16 ms (±2) for the unaspirated tense /p'/. In the carrier phrase, on the other hand, mean values and the standard deviations for VOT were 40 ms (±7) in /b/, 75 ms (±8) in /p^h/ and 10 (±2.1) in /p'/. In the study, altogether the standard deviation as percentage of the mean value of VOT ranged from 11% to 21%, giving mean 14.4%. This is similar to the case with VOT in BrEng stops. In a study with four BrEng speakers with isolated VCV words, altogether the mean VOT and its standard deviation was 58.63 ms (±13.47) for voiceless stops and 23.13 ms (±5.08) for voiced stops. However, in the case of the voiced stops in English natural speech the variability (±31.08) in voicing is 48% of the mean value (64 ms) (Kim 1989). The amount of variability in voicing (±31.08) was 3.3 times greater than the case with VOT in the Korean word-initial bilabial stops in a semi-natural speech although they are not directly comparable due to various factors, such as subjects, test-materials, etc. The extremely large variability in voicing during the oral closure phase of voiced stops suggests that in English the [voice] would be one of potential phonetic correlates of the phonologically voiced stop but not a phonological feature.

Moreover, in the case of stops the voicing can not be audible

in the formation of occlusion since the vocal tract is sealed. The inaudible voicing during the occlusion phase and the amount of variability of voicing leads us to assume that the usability of the feature [voice] as a perceptual cue for the phonologically voiced stops may be negative. This assumption has been proved by Port's (1979) findings. In a perceptual experiment using a computer controlled tape-splicing method, Port (1979) found that "an intervocalic /b/ [in 'rabid'] will remain perceptually voiced even when all traces of glottal pulsing have been removed from the closure interval, as long as the closure interval is kept sufficiently short, i.e., less than 75 ms, and if the silent closure interval is lengthened, i.e., greater than 130 ms, American listeners will hear voiceless stops" (for a similar result, see Lisker 1957). Considering the large amount of variability of voicing in production (e.g., Kim 1984, 1987, 1989; Flege and Brown 1982; Lisker and Abramson 1964) and the perceptual judgement (Port 1979; Lisker 1957), it is reasonable to conclude that the usability of the feature [voice] as a phonetic cue for the phonologically voiced stop is negative in both production and perception.

3. Conclusion

There is no phonetic evidence for the voiced-voiceless distinction both in production and in perception. The feature [voice] appears to be one of potential phonetic correlates of the phonologically voiced stop. It is improper to use the [voice] as an independent phonological marker, regardless of position (word-initial, intervocalic, word-final). A feature other than the voiced-voiceless feature must distinguish /b, d, g/ from /p, t, k/. For a tense-lax distinction, Kim (2002) shows a novel analysis of the air pressure signals that occur during stops. Further systematic investigations are needed on the tense-lax distinction.

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